AMENDMENTS TO THE CLAIMS

1. (Original) A fluorescence endoscopy video system including:

a multi-mode light source for producing various light outputs, including a number of optical filters that selectively alter the spectral characteristics of the light produced by the light source including:

a light source filter for blue light fluorescence excitation and reflectance imaging at blue wavelengths;

a light source filter for red light reflectance imaging at red wavelengths; and

a light source filter for green light reflectance imaging at green wavelengths, wherein said filters are operable such that the light source can produce sequential red, green and blue light for white light imaging or continuous fluorescence excitation light for fluorescence imaging;

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an endoscope for directing the light from the light source into a patient to illuminate a tissue sample and to collect the reflected light and fluorescence light produced by the tissue;

a camera positioned to receive the light collected by the endoscope, the camera including:

an image sensor;

a low light image sensor;

a beamsplitter for splitting the light received from the tissue sample into two beams and projecting the two beams onto the image sensor and low light image sensor;

a filter positioned in front of the low light sensor for selectively transmitting light of desired wavelengths; and

one or more optical imaging components that project images onto both the image sensor and low light image sensor.

an image processor/controller coupled to the camera for digitizing, storing, processing and encoding the image signals received from the image sensor and low light image sensor as video signals; and

a color video monitor that receives the video signals and displays them.

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2. (Original) The system of Claim 1, wherein the camera is attached to the portion of the endoscope that remains outside of the body.

3. (Original) The system of Claim 1, wherein the camera is built into the insertion portion of the endoscope.

4. (Original) The system of Claim 2 or 3, wherein the beamsplitter directs a greater percentage of light collected by the endoscope to the low light image sensor and a lesser percentage to the image sensor.

5. (Original) The system of Claim 2 or 3, wherein the light source optical filter for blue light output transmits blue fluorescence excitation light and blocks light from the light source at wavelengths in a fluorescence detection wavelength band from reaching the camera to the extent that the light received by the camera is substantially composed of light resulting from tissue fluorescence and reflected fluorescence excitation light and minimally composed of light at wavelengths other than those used for fluorescence excitation originating from the light source.

6. (Original) The system of Claim 5, wherein a filter positioned in front of low light image sensor blocks reflected excitation light and transmits primarily fluorescence light to the extent that the light received by the low light image sensor is substantially composed of light resulting from tissue fluorescence and minimally composed of light originating from the light source.

7. (Original) The system of Claim 6, wherein the fluorescence light transmitted by the filter in front of the low light image sensor is green light

8. (Original) The system of Claim 7, wherein the low light sensor has light sensitivity that varies synchronously with the light source output such that the light sensitivity of the low light image sensor is higher during the period of blue light output and lower at other times.

9. (Original) The system of Claim 6, wherein the fluorescence light transmitted by the filter in front of the low light image sensor is red light.

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10. (Original) The system of Claim 9, wherein the low light sensor has light sensitivity that varies synchronously with the light source output such that the light sensitivity of the low light sensor is higher during the period of blue light output and lower at other times.

11. (Original) The system of Claim 7, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during blue light excitation and an image created from blue reflectance light acquired by the image sensor, said images being superimposed and displayed in different colors on the color video monitor.

12. (Original) The system of Claim 9, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during blue light excitation and an image created from blue reflectance light acquired by the image sensor, said images being superimposed and displayed in different colors on the color video monitor.

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13. (Original) The system of Claim 7, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue light excitation, and an image created from red reflectance light acquired by the image sensor during a period of red light illumination, said images being superimposed and displayed in different colors on the color video monitor.

14. (Original) The system of Claim 9, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue light excitation, and an image created from red reflectance light acquired by the image sensor during a period of red light illumination, said images being superimposed and displayed in different colors on the color video monitor.

15. (Original) The system of Claim 7, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue light excitation, and

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an image created from green reflectance light acquired by the image sensor during a period of green light illumination, said images being superimposed and displayed in different colors on the color video monitor.

16. (Original) The system of Claim 9, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue light excitation and an image created from green reflectance light acquired by the image sensor during a period of green light illumination, said images being superimposed and displayed in different colors on the color video monitor.

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17. (Original) The system of Claim 7, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light, acquired by the low light sensor during a period of blue illumination, and an image created from red reflectance light acquired by the image sensor during a period of red illumination, said images being superimposed and displayed in different colors on the color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed red, green, and blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

18. (Original) The system of Claim 7, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from blue reflectance light acquired by the image sensor during a period of blue illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image consisting of superimposed red, green, and blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

19. (Original) The system of Claim 9, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of light source blue illumination, and an image created from green reflectance light acquired by the image sensor during a period of green illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed red, green, and blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

20. (Original) The system of Claim 9, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from blue reflectance light acquired by the image sensor during a period of blue illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed red, green, and blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

21. (Original) A fluorescence endoscopy video system including:

a multi-mode light source;

a number of moveable optical filters including a filter for producing blue excitation and reflectance light, a filter for producing red reflectance light, and a filter for producing green reflectance light;

a mechanism for moving the filters in front of the light source to produce continuous excitation light or sequential red, green and blue reflectance light in synchronism with a video field;

an endoscope for directing the light from the light source into a patient to illuminate a tissue sample and to collect reflected light and fluorescence light produced by the tissue;

a camera positioned to receive the light received from the tissue, the camera including:

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an image sensor, the image plane of the image sensor being perpendicular to the image plane of the front of the camera;

a low light image sensor, the image plane of the low light image sensor being perpendicular to the image plane of the front of the camera;

a beamsplitter for splitting the light received from the tissue into two light beams that are directed onto the image sensors;

a mirror for directing one of the two light beams onto one of the image sensors;

a filter positioned in front of the low light sensor for selectively transmitting light of desired wavelengths; and

two or more optical imaging components that project images onto both the image sensors.

an image processor/controller coupled to the image sensors for storing, processing and encoding the image signals received from the sensors as video signals; and

a color video monitor that receives the video signals and displays them.

22. (Original) The system of Claim 21, wherein the camera is attached to the portion of the endoscope that remains outside of the body.

23. (Original) The system of Claim 22, wherein the beamsplitter directs a greater percentage of light collected by the endoscope to the low light image sensor and a lesser percentage to the image sensor.

24. (Original) The system of Claim 21, wherein the camera is built into the insertion portion of the endoscope.

25. (Original) The system of Claim 24, wherein the beamsplitter directs a greater percentage of light collected by the endoscope to the low light image sensor and a lesser percentage to the image sensor.

26. (Original) The system of Claim 22 or 24, wherein the light source optical filter for blue light output transmits blue fluorescence excitation light and blocks light from the light source at wavelengths in a fluorescence detection wavelength band from reaching the camera to the extent that the light received by the camera is substantially composed of light resulting from

tissue fluorescence and reflected fluorescence excitation light and minimally composed of light at wavelengths other than those used for fluorescence excitation originating from the light source.

27. (Original) The system of Claim 26, wherein a filter in front of low light image sensor blocks reflected excitation light and transmits primarily fluorescence light to the extent that the light received by the low light image sensor is substantially composed of light resulting from tissue fluorescence and minimally composed of light originating from the light source.

28. (Original) The system of Claim 27, wherein the fluorescence light transmitted by the filter in front of the low light image sensor is green light.

29. (Original) The system of Claim 27, wherein the fluorescence light transmitted by the filter in front of the low light image sensor is red light.

30. (Original) The system of Claims 28 or 29, wherein the light sensitivity of the low light image sensor varies synchronously with the light source output such that the light sensitivity of the low light image sensor is higher during the period of blue light output and lower at other times.

31. (Original) The system of Claim 28, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light by the low light image sensor and an image created from blue reflectance light by the image sensor that are superimposed and displayed in different colors on the color video monitor.

32. (Original) The system of Claim 29, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light by the low light sensor and an image created from blue reflectance light by the image sensor, said images being superimposed and displayed in different colors on the color video monitor.

33. (Original) The system of Claim 28, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue light excitation, and

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an image created from red reflectance light acquired by the image sensor during a period of red light illumination, said images being superimposed and displayed in different colors on the color video monitor.

34. (Original) The system of Claim 29, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue light excitation, and an image created from red reflectance light acquired by the image sensor during a period of red light illumination, said images being superimposed and displayed in different colors, on the color video monitor.

35. (Original) The system of Claim 28, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue light excitation, and an image created from green reflectance light acquired by the image sensor during a period of green light illumination, said images being superimposed and displayed in different colors, on the color video monitor.

36. (Original) The system of Claim 29, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue light excitation, and an image created from green reflectance light acquired by the image sensor during a period of green light illumination, said images being superimposed and displayed in different colors, on the color video monitor.

37. (Original) The system of Claim 28, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from red reflectance light acquired by the image sensor during a period of red illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed images created from red, green, and

blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

38. (Original) The system of Claim 28, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from green fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from blue reflectance light acquired by the image sensor during a period of blue illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed images created from red, green, and blue reflectance light images acquired by the image sensor during periods of red, green, and blue illumination respectively.

39. (Original) The system of Claim 29, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from green reflectance light acquired by the image sensor during a period of green illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed images created from red, green, and blue reflectance light acquired by the image sensor during periods of red, green, and blue illumination respectively.

40. (Original) The system of Claim 29, wherein the image processor/controller creates a composite fluorescence/reflectance image comprising an image created from red fluorescence light acquired by the low light sensor during a period of blue illumination, and an image created from blue reflectance light acquired by the image sensor during a period of blue illumination, said images being superimposed and displayed in different colors on a color video monitor, wherein said composite fluorescence/reflectance image is displayed simultaneously with a composite color image, consisting of superimposed images created from red, green, and

blue reflectance light acquired by the image sensor during periods of red, green, and blue illumination respectively.

41. (Currently amended) A fluorescence endoscopy video system including:

a multi-mode light source for producing white light, fluorescence excitation light or fluorescence excitation light with a reference reflectance light;

an endoscope for directing the light from the light source into a patient to illuminate a tissue sample and to collect reflected light or fluorescence light produced by the tissue;

a camera positioned to receive the light collected by the endoscope, the camera including:

a low light <u>color</u> image sensor having integrated filters with color output;

one or more filters positioned in front of the low light color image sensor for selectively blocking light with wavelengths below 470 nm and transmitting visible light with wavelengths greater than 470 nm; and

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one or more optical imaging components that project images onto the low light color image sensor;

an image processor/controller that receives image signals from the low light color image sensor and combines and interpolates image signals from pixels having filters with the same integrated filter characteristics to fluorescence or reflectance light and then encodes the images as video signals; and

a color video monitor for displaying superimposed video images from the pixels of the low light image sensor.

42. (Original) The system of Claim 41, wherein the camera is attached to the portion of the endoscope that remains outside of the body.

43. (Original) The system of Claim 41, wherein the camera is built into the insertion portion of the endoscope.

44. (Original) The system of Claim 42 or 43, further comprising a light source filter positioned in the light path of the light source that simultaneously transmits the fluorescence excitation light at wavelengths less than 450 nm and an amount of reference reflectance light not in a fluorescence detection wavelength band, wherein the amount of reference reflectance light

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transmitted is a fraction of the fluorescence excitation light, such that the ratio of the intensity of the reflected reference light projected onto the low light color image sensor to the intensity of fluorescence also projected onto the low light color image sensor allows abnormal tissue to be viewed, the light source filter also blocking light from the light source at wavelengths in the fluorescence detection wavelength band such that the fluorescence light received by the low light color image sensor is substantially composed of light resulting from tissue fluorescence and minimally composed of light originating from the light source.

45. (Currently amended) The system of Claim 44, wherein the fluorescence light, transmitted by at least one filter in front of the ~~high sensitivity~~ low light color image sensor, is green light

46. (Currently amended) The system of Claim 44, wherein the fluorescence light, transmitted by at least one filter in front of the ~~high sensitivity~~ low light color image sensor, is red light.

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47. (Original) The system of Claim 45, wherein the reference reflectance light, not in the detected fluorescence band, transmitted by the light source filter is red light.

48. (Original) The system of Claim 47, wherein the image processor/controller produces a composite fluorescence/reflectance image comprising an image created from green fluorescence light and an image created from red reflectance light that are superimposed and displayed in different colors on a color video monitor.

49. (Original) The system of Claim 46, wherein the reference reflectance light, not in the detected fluorescence band, transmitted by the light source filter is green light.

50. (Original) The system of Claim 46, wherein the image processor/controller produces a composite fluorescence/reflectance image comprising an image created from red fluorescence light and an image created from green reflectance light that are superimposed and displayed in different colors on a color video monitor.

51. (Original) The system of Claim 42 or 43, further comprising a filter positioned in the light path of the light source that transmits fluorescence excitation light at wavelengths less than 450 nm and blocks light at visible wavelengths longer than 450 nm, from reaching the low

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light color image sensor to the extent that the light received by the low light color image sensor is substantially composed of light resulting from tissue fluorescence and minimally composed of light originating from the light source.

52. (Original) The system of Claim 51, wherein the image processor/controller produces a composite fluorescence/reflectance image comprising an image created from green fluorescence light and an image created from red fluorescence light that are superimposed and displayed in different colors on a color video monitor.

53. (Original) The system of Claim 42 or 43, further comprising a filter positioned in the light path of the light source that simultaneously transmits blue light at wavelengths less than 480 nm and amounts of green and red light, wherein the amounts of red and green light transmitted are adjusted to be a fraction of the transmitted blue light, such that, when reflected from a gray surface, the intensity of the green and red light projected onto the low light color image sensor matches the intensity of blue light also projected onto the low light color image sensor in such a way that the resulting color images are white balanced.

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54. (Original) The system of Claim 53, wherein the image processor/controller produces a composite color image comprising red reflectance light, green reflectance light, and blue reflectance light images that are superimposed and displayed respectively on red, green, and blue channels of a color video monitor.

55. (Currently amended) A system for producing white light and/or autofluorescence images at video frame rates, comprising:

a light source that produces sequential blue, red and green light, wherein the blue light can produce tissue autofluorescence;

an endoscope for delivering light from the light source to an in-vivo tissue sample;

a camera positioned at the distal tip of the endoscope; the camera including:

an image sensor;

a low light image sensor;

a filter that substantially blocks reflected blue light from reaching the low light image sensor; and

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a beamsplitter for directing a percentage of light received from the tissue to the low light image sensor and a lesser percentage of light received from the tissue to the image sensor; and

an image processor/controller coupled to the image sensors that stores images created from red, green and blue reflectance light ~~acquireed~~ acquired by the image sensor and autofluorescence images created from autofluorescence light acquired by the low light sensor in response to blue light,

wherein said processor selectively outputs images created from red, green, blue reflectance light and/or an image created from the autofluorescence light to a display for white light or fluorescence/reflectance imaging.

56. (Original) A camera for use in a video endoscope, including:

a low light image sensor;

an image sensor;

a fixed beam splitter that directs a percentage of light to the low light image sensor and a lessor percentage of light to the image sensor;

a filter that limits the amount of reflected excitation light that reaches the low light sensor; and

imaging optics to focus light on the low light and image sensors,

wherein said low light image sensor and image sensor can simultaneously produce an autofluorescence and a reflectance image when positioned to receive autofluorescence light and reflected excitation light.

57. (Original) A system for producing white light and/or autofluorescence images at video frame rates, comprising:

a light source that produces blue light for fluorescence excitation and reference reflectance light or modified white light with reduced green and red content for white light imaging;

an endoscope for delivering light from the light source to an in-vivo tissue sample;

a camera positioned at the distal tip of the endoscope; the camera including:

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a low light color image sensor; and

a filter that substantially blocks reflected excitation light from reaching the low light image sensor; and

an image processor/controller coupled to the low light color image sensor that produces red, green, and blue reflectance images from images acquired by the low light color image sensor in response to the modified white light and autofluorescence and reflectance images from images acquired by the low light color image sensor in response to blue excitation light and reference reflectance light,

wherein said processor selectively outputs red, green and blue reflectance images for white light imaging or an autofluorescence image and a reflectance image for fluorescence/reflectance imaging.

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58. (Original) A system for producing white light and/or autofluorescence images at video frame rates, comprising:

a light source that produces blue light for fluorescence excitation or a modified white light with reduced green and red content for white light imaging;

an endoscope for delivering light from the light source to an in-vivo tissue sample;

a camera positioned at the distal tip of the endoscope; the camera including:

a low light color image sensor; and

a filter that substantially blocks reflected blue light from reaching the low light color image sensor; and

an image processor/controller coupled to the low light color image sensor that produces images from light passing through different pass-bands of a filter positioned in front of, or integral with, the low light color image sensor in response to illumination of the tissue sample with the modified white light and autofluorescence images created from light passing through different pass-bands of the filter in response to illumination of the tissue sample with blue excitation light,

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wherein said image processor/controller selectively outputs images created in response to the modified white light to a color monitor to produce a composite white light image or autofluorescence images to a color monitor.

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